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# Integrating business simulations software into learning environment of technical university

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**Abstract.** The development of active learning approaches and the need in raising economic competency of the people within all the age groups brings business simulations software to the front of the appropriate tooling lists. The aim of the study considers the ways and approaches to introduce and effectively integrate business simulations software into learning environments of technical university. The object of the study is the learning environment of Technical University. The subject of the study is using business simulations software in the learning environments of technical university. The result of the study: several approaches of integrating business simulations software into a learning environment of technical university were analyzed and discussed. The paper is dedicated to generalizing practical experience of the authors in technical and logical implementation in the pedagogical practice, usage of business simulations software as students and users with theoretical research of broader set of approaches used to integrate business simulations software into educational software-based and organizational environments. Conclusions and future plans based on the results of the experiments were made. Main conclusions and recommendations: the range of approaches between deep integration with the learning management tools used in the learning environments and independent usage of business simulations software is possible to implement. Choice of approach depends on the goals, ICT-related maturity of the learning infrastructure and the percentage of active learning cases in the syllabus of the class. Future experimentation is needed to collect extensive data on integration possibilities, efficiency and effectiveness of the level of integration of business simulations software into learning environment of technical university.

## 1. Introduction

The concept of active learning has been widely discussed since its substantial introduction and description in the last decade of 20th century. Research results conclude a significant positive influence of the active learning approaches to the educational results [1, 2]. Cooperation, collaboration and group activities embedded into active learning practices provide the most significant outcome [3]. Among modern ICTs in the field of economics, scientists are distinguishing business simulations. Using business simulations to enrich classes on the economy, finance, classical and behavioral is an example of active learning, need to be used in modern learning environments.



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Business simulations software, providing significant possibilities to implement active learning approaches in studying economy to the classrooms of schools, higher education establishments and corporate learning environments. There is a need in developing approaches and ways to introduce and integrate business simulations software into educational environments of technical university. Business simulations software are being used by educational institutions of all levels and corporate training establishments as a valuable part of the classes and training in economics and finance. They might be used as the mean for formation of economic competence of the students. Finance literacy in high school is being developed more efficiently and with better involvement of the students [4].

While using business simulations software in the educational process has some coverage by researches and discussions, integrating simulations into a learning environment technical university is less discussed. Logical integration of business simulations into curriculum have been discussed by academics and practitioners. Approaches of implementing of business simulations usage into the educational process of higher education establishments were offered and discussed using MobLab and Economics Games software complexes. Descriptive example of integrating business simulations not only into a classroom, but also into scientific research, based on the collected during simulations data is described in the “General Economic Principles of Bargaining and Trade: Evidence From 2,000 Classroom Experiments” paper with the team of authors [5]. Educational institutions have technological setup, consisted of systems of ICT environment virtualization, authorization systems, Learning Management Systems (LMS), Learning Record Systems (LRS), Student information management systems, etc.

Business simulations themselves are the valuable tools to let students immerse in the experience otherwise impossible, expensive or dangerous to have. This is passive usage of the active learning tool. Technical universities with Computer Science, Information Technologies, Mathematical Modelling and alike specialties available may benefit from integration of business simulations software development into their educational activities.

That is why in this study, business simulators will be understood as the software of business simulations, and the modern educational environment – the educational environment of the Technical University.

Recently, scientists around the world are paying more and more attention to the educational environment [6–10]. In particular, Nataliia Soroko considered methodology for Teachers’ Digital Competence Developing through the Use of the STEAM-oriented Learning Environment [11], Sanchia Janita Prameswari and Cucuk Budiyanto investigated the development of the effective learning environment by creating effective teaching in the classroom [12]. Aysen Ozerem and Buket Akkoyunlu also considered learning environments designed according to learning styles and their effects on mathematics achievement [13]. Ezigi Ibem, Oluwole Alagbe, Abraham Owoseni in their joint work considered students’ perception of the learning environment [14]. Rudite Andersone investigated the learning environment in today’s school in the context of content reform of curriculum [15].

Modern ICT setup of the educational institutions is mostly cloud-based [16–29]. Principles of the cloud-based ICT environment creation were discussed, the models of the general structure and the private academic cloud of the modern university were presented in the publication of Olena H. Glazunova. The architecture of information-educational environment of the modern university was substantiated and the number of solutions was presented for implementation of the modern ICT infrastructure in the higher education establishment in the publication of Olena H. Glazunova and Oleksandr V. Yakobchuk [30, 31]. A cloud-oriented green computing architecture for E-Learning applications was proposed and described in the paper of K. Palanivel and S. Kuppuswami [32]. Marinela Mircea and Anca Ioana Andreeescu in their study analyzed the possibilities, conditions and enablers of the migration universities ICT resources to the efficient cloud-based infrastructure [33].

The options of integrating business simulations into technological ICT setup of modern learning environments are being analyzed in this study.

It is already discussed that learning happens when effective educational strategies are being combined with technological tools, effectively and sometimes also efficiently enriching learning experiences. Triple E Framework substantiates and describes one of the approaches to choose and validate the appropriate combination of the traditionally proven teaching techniques with technology usage. Three main principles of the Framework are: engage with others in social interactions, enhance and extend class learning to the real world application cases [34]. Principle of enhancement require leveling up “order of thinking” needed to perform learning activities [35].

The purpose of the work is to analyze, classify and generalize the approaches to the integration of the business simulation into the technical education environment and educational activities.

## 2. Results

### 2.1. Business simulations as specific type of educational tools

Educational environment as the term and the phenomenon is being rapidly evolving these days. The educational environment might be defined as the set of material objects and their connections that form a system for educational activities of learning subjects [36]. Another definition might be found in the works of Valeriy Yu. Bykov. Scientist highlights the educational environment as an artificially created system with the structure and components, enabling reaching educational goals [37]. Modern learning environment requires a synergistic complex of modern pedagogy with modern ICT and learning tools. Educational (learning) tool is being defined as the didactic system element that forms a learning environment and is being used in an educational activity. Business simulations are one of the examples of the learning tools used in the modern learning environment to introduce active learning approach and some degree of practical and visualized activity to the class.

The present state of the business simulations development and implementation characterizes by the absence of a dominant leader or unity of approaches to the organizations of the business simulation complexes. Business simulations might be simple standalone applications, open web or (and) mobile applications, online games, collections of separate simulations and complexes, hosted by vendors or integrated into the ICT environments of publishers or educational establishments.

Business simulations are being used as educational tools within different educational establishments. Business schools, universities and colleges use business simulations to add active learning and practical trainings to the MBA programs as well as to Masters and Bachelors curriculum. Executive programs from the traditional educational establishments and from corporate educational centers embed business simulations into their educational process. Business simulations are able to model simple economic concept, functional or operational area of the company, financial situation or process. Both classical and behavioral economy and finance concepts may be modelled and simulated. Visualization of the economic concepts or quantitative functional areas gives a better understanding and some level of hands-on experience to the students, using business simulations in their courses. Qualitative variables and interactions with the students might also be implemented into the logic of business simulations. An important area of using and value creation for business simulations in scientific research. Data generated during educational usage of business simulations might be used to study economic or behavioral concepts. Educational and scientific usage of business simulations might be combined within properly organized disclosed experiments conducted during the classes. The problem-based workshop is another educational form where business simulation usage as a learning tool is advised. Business simulations are being productively employed by the corporations to augment teaching the ways to use their products to the customers. One of the proven productive approaches is to use business simulations to teach customers to use ERPs [38].

Authors used business simulations in their educational activities for more than 16 years. Personal experience ranges from business simulations design for academic purpose as well as for corporate marketing purpose, using them to teach classes for Master students, employing business-simulations to introduce game theory to the high-school students, giving problem-based workshops in the corporate educational activities and playing simulations being a student of Global Executive MBA program. There were simple “one step” simulations, complex single-payer corporate operational simulations and competitive simulation, played by the remote diverse team in 5 different countries. Business simulations cover a wide range of topics and knowledge areas as well as a broad set of purposes and are being used for one as well as for hundreds of students simultaneously. Some business simulations are implemented in online games and let students interact with an extensive set of counterparts and diverse economic entities [39].

Business simulations follow general patterns of usage and integration of the other types of educational content. They have a lot of characteristics like other types of content and multimedia used in educational activities. We may observe a high level of similarity in the ways to create, host and use between business simulations and tests. Being close to each other in the use case scenarios, business simulations have several specific differences:

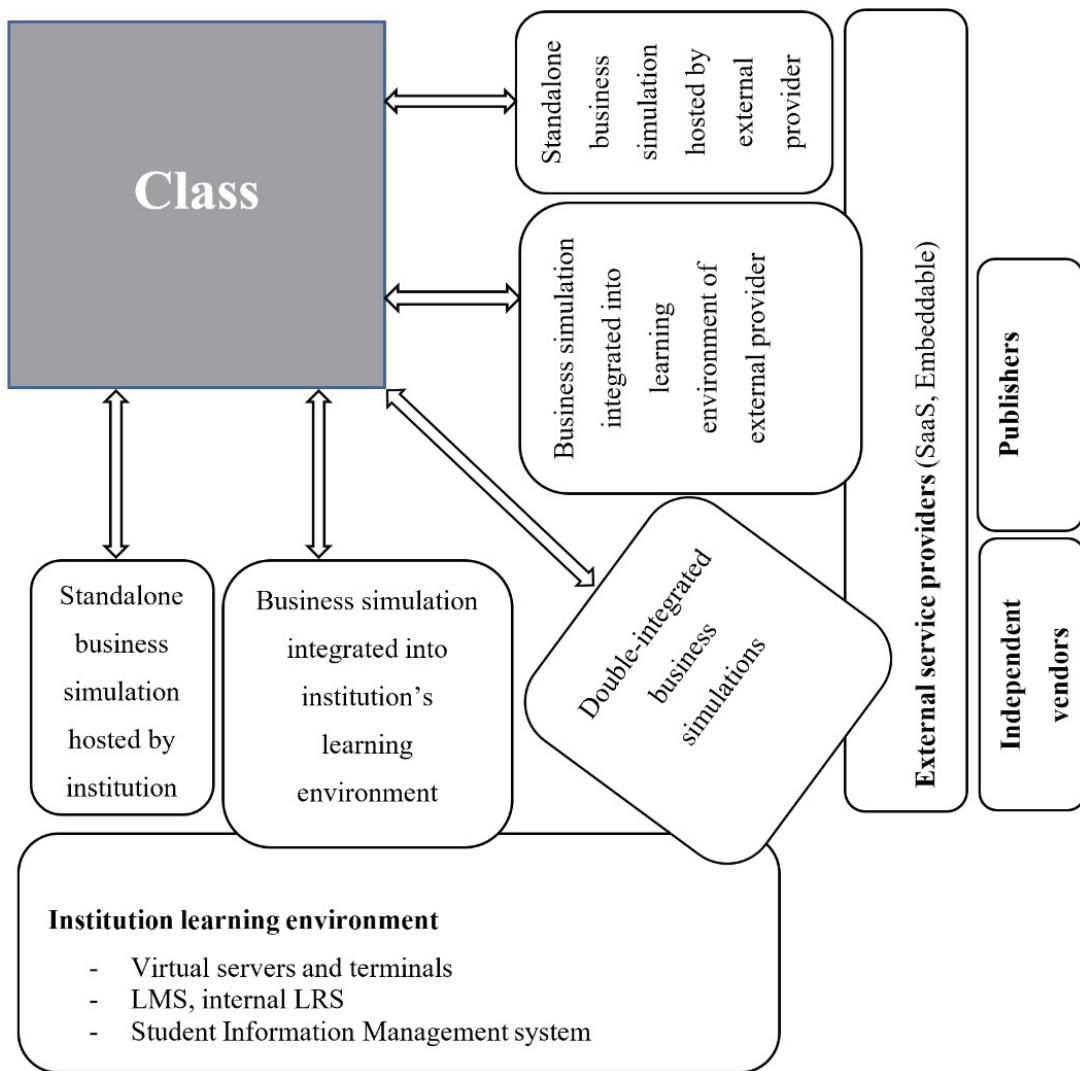
- they don't have standardize formats of presentation and interactions with the system (like the type of questions in the tests),
- might have complex logic of interaction with the user (some algorithmic/conditional logic might be present in adaptive tests, but it usually will be more consequent),
- might incorporate interaction with other users, working with the same simulation,
- are following developments in mathematics, economics, game theory, etc. The concept of different nature from other areas of science is being implemented in business simulations.

This specific defines the ways business simulations might be integrated to the modern learning environments of the educational establishments of all types. Neither type of integration we acknowledge as the right one. The set of approaches for each specific educational systems and situation will be discussed. The dominating types of integration are visualized on figure 1 and described in table 1. Mentioning “educational institution” we mean: university, college, school, training center, corporate training facilities. Mentioning “external provider” we mean either company or a private person – developer of the business simulation or publisher, providing a wide range of business simulators and (or) educational materials of other types.

## *2.2. Integration of business simulations*

This work will be dedicated to the server- (web-) based simulations. Majority of the modern business simulations and complexes of the simulations are built using this approach. The user interface in case of web-based simulations and complexes of simulations might be implemented as: web-page (web-site); native application for one or several mobile platforms; adaptive web-page, allowing appropriate representation on the screens of the mobile devices; combination of several or all above-mentioned options.

Following currently accepted by default trend in the software development organization, business simulation developers usually start from the creation of single simulation as MVP (minimum viable product), test it with the target audience (teachers and students), correct the product and expand the offering, adding other simulations of enhancing the present one. It results that initially, business simulation is a simple server web-based application, that might be installed on the servers of educational establishment or on the server of simulation producer. We call it “standalone” setup. The business simulation might be used as real SaaS [40] offering, where instances of simulation environment for each game/class are being created automatically.



**Figure 1.** Business simulation integration approaches.

A simpler option for the producer that just starts to test hypotheses, might be used as “semi-SaaS” where simulation environments are being manually created for each game/class.

The same approach to hosting of business simulations is usually being used when it is being created by some educator (teacher/professor/lecturer), sometimes in collaboration with the students for particular class or topic.

After business simulation proved its usefulness and (or) profitability, the set of simulations is being developed using the same platform. Simulations are being used by the wider audience on the infrastructure of a producer or educational establishment that defines the need in the simulations and user (both: educators and student) management functionality. It requires integration either into the technical learning environment of educational institution or external provider. The same complex of business simulations might have the functionality to be integrated into the technical learning environment of either party.

The other approach might be used by the established education materials creating companies and publishers, who may order to create separate simulation as an addendum or enhancement to the available book, course or material set. This is the case when business simulation usually

**Table 1.** Business simulation technical integration approaches. Description.

Integration approach	Description	Educational setup
Standalone business simulation hosted by institution	Software, representing business simulation is hosted on the server of the educational establishment and is a separate program. Might have a different type of user interface (web, mobile, native application etc.)	Educational establishments, corporate learning centers
Standalone business simulation hosted by external provider	Software, representing business simulation is hosted on the server of the external provider and is a separate program. Might have a different type of user interface (web, mobile, native application etc.)	Educational establishments, corporate learning centers, private trainers.
Business simulation integrated into institution's learning environment	Software, representing business simulation is hosted on the server of the educational establishment and has integration with the other software systems of educational institutions.	Educational establishments, corporate learning centers.
Business simulation integrated into learning environment of external provider	Software, representing business simulation is hosted on the server of the external learning provider. May have matching or integration with the learning content and materials of other types.	Educational establishments, corporate learning centers, private trainers, private learners.
Double-integrated business simulation	Software, representing business simulation is hosted on the server of external learning provider, in the same time integrated with the other software systems of educational institutions. May have matching or integration with the learning content and materials of other types on the resources of the external learning provider.	Educational establishments, corporate learning centers.

appears in the category of “Business simulation integrated into the learning environment of external provider” from the time of creation.

The next level of integration is “Double-integrated business simulation”. We call business simulations “double-integrated” when simulations management and user management are integrated with the technical learning environments of the external provider and learning institution simultaneously. In this case complex of business simulations or single business simulation is hosted on the physical infrastructure of the external provider (might be server, private, public or hybrid cloud), is integrated into its authentication, authorization, the other systems, and, in the same time, is integrated to some systems of the technical educational environment of an educational establishment.

This type of integration enables producer or external provider to enhance and update the software continuously and provide the educational establishment with qualitative service within a reasonable time and with lower cost. Maintaining software on its own infrastructure is easier and more efficient for the external provider. The educational establishment has the next benefits from this level of integration: continuous updates and bug-fixes of business-simulations; absence of the need to install and maintain the software in its technical educational infrastructure; integration

with its authentication, authorization, Learning Management Systems, Student Information Systems etc.

So-called “White-label” solutions are the logical type of presenting different types of products to the customers. In the case of business simulations, it means that a company develops a complex of business simulations and let educational establishments to label it with its brand to their students. “White-label” business simulation might be used by the educational establishments in most part of above-mentioned integration approaches, except “Business simulation integrated into the learning environment of external provider”. This type of integration is being used to benefit from integration with the systems and content of an external provider, so branding of the external provider will be part of the beneficial offering for the students and educator.

Technical integration of the business simulations into the educational environment of modern educational establishments need to be defined by:

- the goals of the institution and its educators;
- the familiarity of the educators with using business simulations in the educational process in general and either particular business simulation or complex to be integrated fits the educational goals of the institution, educators and the students;
- financial and technical abilities of the educational establishment;
- type of the audience to use the business simulation for (permanent students, students of short-term courses, distance learners, technical savviness).

The type of integration might be also defined by the policy of producer of business simulation or publisher.

### *2.3. An educational approach to use business simulations*

Another point of attention to use business simulations is an efficient and effective logical integration of the business simulation into the educational process.

Approaches to logically integrate business simulations into the educational process are presented in the table 2.

An important question to address from the author’s personal experience and analyzes sources is the preparation process for using business simulation in the class. Different logical and technological integration approaches might require the preliminary setup of the business simulation by the teacher or lecturer. An additional hurdle is the registration of the students in the simulation. These points need to be carefully addressed within the preparatory phase of business simulation usage to make it efficient and effective within the educational process.

## **3. Conclusion**

As a result of the study, the approaches to integrating business simulations software into learning environment of technical university were presented. The work describes technological setups of learning environment technical university, using business simulations software complexes in the classrooms and for scientific research. Business simulations software might be used as standalone applications on the side of the institution or in the infrastructure of solution vendor, they may be integrated either into the technological environment of educational establishment or vendor, the highest level of integration is double-integration into both infrastructures of institution and vendor. Logical integration of the business simulations into the educational process was shortly named and described. Significance of the preparatory phase before using business simulations was mentioned. Simplification of the business simulation usage for short easy-to-use simulations and double-integrated solutions need to be further studied, idealized and developed.

**Table 2.** Business simulation logical integration approaches.

Logical integration approach	Description
Short inclusion	Business simulation is the short inclusion into the educational process to visualize particular economic concept or theory
A meaningful integral part of the class or workshop	Business simulation is being presented and played introduce active learning approach to the class and to visualize and let students deeper understand the economic or financial topic or a set of concepts.
Simulation-based class or workshop	The business simulation might be used as the basement or "scaffold" for either particular problem- or topic-based workshop or even complete class.
Group or individual in-class or home assignment	Business simulation is being used to organize in-class or home assignment for an individual or a group.
Scientific tool	Business simulation is being used to collect needed data from the class or workshop participants. The purpose of using business simulation to collect data might be disclosed to the class or not. It might influence experiment results. Sometime bias of disclosure might be predicted and intentionally expected.

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